ELECTRONIC CONTROL UNIT

Prior Art

The invention relates to an electronic control unit ~~having the characteristics recited in the preamble to claim 1~~.

From German Patent Disclosure DE 196 05 966 A1, a component board for an electronic control unit is already known that is provided with a plurality of electronic modules on its assembly side. Each of the electronic modules is provided with a respective electronic circuit, which independently of the other electronic modules generates at least one separate function of the control unit. By combining various electronic modules on the component board, the control unit can be adapted to a given profile of requirements with regard to the triggering of various operating units. For instance, it is possible for a plurality of electronic modules for controlling the engine, anti-lock braking system, electronic gas pedal, adaptive cruise control radar, actuators, or other operating devices of a motor vehicle to be disposed on a component board in a central control unit of the motor vehicle.

A disadvantage of the known control units is that the component board for connecting the operating devices is provided with electrical ~~contact~~ contacts through a push-on terminal strip or conductor foil, which is connected to plug connectors

outside the control unit. The conductor foil or push-on terminal strip is electrically connected on one side of the component board to the printed circuit conductors of the component board, for instance by soldering or via bonding ~~bond~~ wires. Since all the terminals are disposed on one side of the component board, a complicated course of printed conductors on the component board is required for electrically connecting the many connection lines with associated electronic modules. For instance, some printed conductors must be extended across the entire component board to an electronic module located at a distance from the push-on terminal strip. Furthermore, the component board must be adapted to the width of the push-on terminal strip or conductor foil; otherwise, not all the contact elements of the push-on terminal strip or conductor foil can be connected to the component board. Since the number of contact elements of the push-on terminal strip or conductor foil increases sharply on the component board as the scale of integration increases, suitably wide component boards must be used, thus increasing the production costs of the control unit considerably and increasing the amount of space required by the control unit in the motor vehicle.

Advantages of the Invention

The control unit of the invention ~~having the characteristics of the body of claim 1~~ overcomes these disadvantages and makes it possible for electronic modules with different control functions to be disposed on the same

component board, without requiring a complicated course of printed conductors or connection of the electronic modules to the same push-on terminal strip. For electrically connecting operating devices, such as operating devices of a motor vehicle, such as the engine, a ABS, electronic gas pedal, adaptive cruise control radar, and so forth, a plurality of separate connector parts provided with contact elements are advantageously disposed directly on the assembly side of the component board; each electronic module is assigned at least one connector part, which is disposed on the component board in the vicinity of this electronic module and is electrically conductively connected to this electronic module via line connections mounted on the component board. Advantageously, by means of the separate connector parts, the disposition and layout of the line connections on the component board are simplified greatly. The separate connector parts are simply connected directly to the adjacently disposed electronic modules via short line connections of the component board. Advantageously, the size of the component board can be reduced and the scale of integration of the control unit can be increased. The control unit can be adapted very simply to different requirement profiles, by either disposing further electronic modules with connector parts assigned to them on the component board or leaving them out. For this purpose, a complicated modification of the layout or conductor course on the component board is unnecessary.

Advantageous features and refinements of the invention are made possible ~~by the characteristics recited in the dependent claims~~.

Advantageously, the connector parts are embodied for receiving counterpart connectors, connected to the connecting lines of the operating devices, which counterpart connectors can be plugged into the connector parts perpendicular to the assembly side of the component board. By this means, an especially high scale of integration on the component board is attained, since no additional space must be made on the sides of the connector parts for inserting the counterpart connectors. The counterpart connectors are electrically contacted with the connector parts simply in a direction perpendicular to the assembly side of the component board.

It is also advantageous to embody the connector parts as surface-mounted components (SMDs), and to solder the contact elements of the connector parts, by their end portions facing toward the assembly side of the component board, onto the line connections of the component board. The SMD connectors can then be soldered to the line connections in a simple way by the easily mastered reflow soldering process.

It is especially advantageous if further line connections are provided on the component board, which without the interposition of electrical or electronic components electrically connect at least some of the contact elements of

a first connector part to one another, or to some of the contact elements of a second connector part. This provision avoids the necessity of providing the operating device connection cables, connected to the push-on terminal strips, with separate terminal strips or connector bridges outside the control unit. In the prior art, such separate terminal strips and connector bridges are required in order to split or separate or join together the individual strands of the cable harnesses outside the control unit. This function of the cable harness can advantageously be taken over by line connections disposed on the component board. In particular, connector bridges, which connect the contact elements of one connector part directly to one another, can advantageously be disposed on the component board.

Advantageously, heat-generating electric power components can be mounted directly on the assembly side of the component board and electrically connected to the electronic modules and/or at least one connector part via line connections of the component board. As a result, a better heat transfer to the underside of the component board is possible, which can for instance be coupled with a heat sink.

It is also advantageous for a common power supply unit and a common signal processing device to be provided for all the electronic modules that are disposed on the component board and to be electrically conductively connected to the electronic modules and/or connector parts via line connections of the

component board. Since this dispenses with a separate signal processing and power supply unit of the electronic modules, the scale of integration of the control unit can be increased still further. The electronic modules themselves can be produced by various production technologies and can thus be optimized in terms of cost for a given electronic module.

Relatively large passive components, which would claim a great deal of space on the electronic modules, can be mounted directly on the assembly side of the component board and be electrically conductively connected to the electronic modules via line connections of the component board. As a result, the size of the electronic modules can be reduced, which is advantageous especially if the electronic modules have an expensive carrier substrate.

It is also advantageous if the electrical control circuit of an electronic module includes at least one microprocessor of its own. Since the control functions of the other electronic modules are not dependent on the computation power of this microprocessor, the microprocessor can advantageously be adapted to the computation power required for the control function of the electronic module. Impairment of the function of the other electronic modules if a single electronic module fails is also avoided. The reliability of the entire system can thus be advantageously enhanced.

For better heat dissipation, the component board can advantageously be mounted, by the side remote from the assembly side, onto a housing part, acting as a heat sink, of the control unit.

Brief Description of the Drawing

One exemplary embodiment of the invention is shown in the drawing and will be described in further detail below.

Fig. 1 shows a perspective, schematic view of a control unit of the invention, without the cap part.

Description of the Exemplary Embodiment

The drawing shows a schematic view of a control unit of the invention with the housing cap removed. A component board 3, which for example can be a multi-layer printed circuit board, a ceramic multi-layer substrate, a plastic carrier with stamped inlay parts, or a three-dimensional printed circuit board, a so-called 3-D MID (molded interconnect device) substrate, or other carrier, is mounted by its underside 5 on a metal housing bottom 2. A housing cap, not shown, can be placed on the housing bottom 2, so that the component board 3 is disposed in protected fashion in a control unit housing. A plurality of electronic modules 10, 11, 12 and 13, which can be made by various technologies, are disposed on the assembly side 4, opposite the underside 5, of the component board 3.

The electronic module 10 for instance includes a printed circuit board or PCB 15, for instance, with a plurality of components 61, 62, 63 connected to one another via printed conductors and disposed on the PCB 15. The electronic module 11 is made by hybrid technology as a ceramic substrate 16, for instance, with components 61, 64. Another electronic module 12 is embodied for instance as multi-chip module (MCM). The electrical and electronic components of the electronic module 13 are mounted directly on the component board and are covered with a protective cap. Still other embodiments of the electronic modules are possible. It is advantageous that not all the control circuits are manufactured by the same production technique, but that instead each of the electronic modules can be made by whatever is the most economical technique for the production.

The electrical and electronic components of each electronic module form an electrical control circuit, each for controlling one operating device disposed outside the control unit. The control unit 1 shown in Fig. 1 can for instance be installed in a motor vehicle for triggering various operating devices of the motor vehicle. The electronic module 10 is intended for instance for triggering an ignition system, while the electronic module 11 is used to trigger an ABS system (anti-lock brake system). Other electronic modules 12, 13 can serve for instance to trigger motor-driven window controls or for controlling an electronic gas pedal. To furnish an additional function of the control unit, a further electronic

module can simply be mounted on the component board. In this way, it is possible to adapt the control unit 1 to a given requirement profile in a very flexible way. Each electronic module has at least one microprocessor 61 of its own, whose computation power is optimally adapted to the control function of the electronic module. A microprocessor assigned to a plurality of electronic modules in common, which must always be designed as large enough that its computation power suffices even if additional electronic modules are included on the component board, is dispensed with. This advantageously prevents the failure of all the electronic modules if the microprocessor of a single electronic module should fail.

A plurality of separate connector parts 20, 21 and 22 are also mounted on the assembly side 4 of the component board 3. Each electronic module is assigned at least one connector part. For instance, the connector part 20 and the connector part 22 are assigned to the electronic module 10, a connector part, not shown, that is to be mounted at the location of the dashed line 23 is assigned to the electronic module 11, and the connector part 22 is assigned to the electronic modules 12, 13. The connector parts are mounted directly on the assembly side 4 of the component board in the vicinity of the electronic modules associated with them, and they are electrically conductively connected to the associated electronic modules via line connections 41 of the component board 3. Each connector part is placed in such a way that taking into account the position of the electronic modules to

which this connector part is assigned, the various line connections 41 to the electronic modules can be made quite short overall. The line connections can be embodied as printed conductors, stamped metal parts, or in some other way. The connector parts 20, 21, 22 include an insulating connector housing, with a plurality of contact elements 50 disposed in ~~it~~. The contact elements 50 are oriented perpendicular to the assembly side 4, so that a respective counterpart connector, which is connected to the connection cable of an operating device, can be inserted into the associated connector part perpendicular to the assembly side 4. The end portions, toward the assembly side 4, of the contact elements 50 are electrically contacted on the underside of the connector housing with the line connections 41. If the connector parts 20, 21, 22 are embodied as SMD (surface mounted device) connectors, then it is possible for instance to solder the contact elements 50 to connection faces 52 of the line connections 41 by reflow soldering. Then the connector parts can advantageously be soldered together with other components to the assembly side of the component board. However, the connector parts can also be soldered with connector lugs, protruding from the underside, ~~in~~ via-holes of the component board, or can be mounted on the component board 3 in some other way. The electronic modules 10-13 can be connected to the line connections in various ways. For instance, the PCB 15 of the electronic module 10 can be provided with contact faces on the underside, which are connected to the components 61, 62, 63 and printed conductors on the top of the PCB 15

~~through~~ via-holes. The contact faces on the underside can then be contacted with the line connections 41 via an electrically conductive adhesive or via solder bumps. It is also conceivable for the electronic circuit of the electronic modules to be contacted with the line connections via bond wires, for instance. As shown, taking the electronic module 12 as an example, the electronic modules can also be provided with terminal pins and soldered directly to the line connections 41 on the assembly side 4.

As also shown in Fig. 1, power components 31 are mounted on the assembly side 4 of the component board 3. The power components 31, which heat up markedly during operation, can advantageously dissipate their heat via the underside of the component board 3 to the metallic housing bottom 2. The power components 31 are connected to the connector parts or electronic modules via high-current-carrying line connections 44 of the component board. Individual discrete components 34 such as large capacitors that would occupy a very great deal of space on the electronic modules can be mounted directly on the component board 3 ~~2~~ and connected to the associated electronic module 10 via line connections 46.

In the component board shown in the drawing ~~Fig. 1~~, it is also provided that there be a common power supply unit 33 on the component board 3. The power supply unit 33 is connected to the electronic modules and/or connector parts via line connections, not shown, of the component board 3, such as a

large-area internal printed conductor of the component board. A signal processing device 32, common to all the electronic modules is also provided, which is connected to the electronic modules and/or connector parts 20, 21, 22 via line connections 45. Thus data, detected for instance by sensors mounted in the vehicle, regarding the temperature, rpm or pressure conditions in the engine can be processed and transmitted to the electronic modules.

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As can also be seen in the drawing ~~Fig. 1~~, individual line connections 42 on the component board are provided which connect a contact element 50 of one connector part to a contact element 50 of another connector part. The cable harness connections of the connection lines can thus advantageously already be made on the component board 3. It is furthermore possible, as shown inside the dashed line 23, to form connector bridges by means of line connections 43 of the component board, which connect two contact elements 50 of one connector part to one another.

A metal cap part, which has recesses for receiving the connector parts 20, 21, 22, is placed on the housing bottom part 2. The connector parts can be sealed off with sealing rings or lines of adhesive in the recesses of the cap part, so that the component board 3 is disposed in a closed control unit housing.

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